CPSC 314
Computer Graphics
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Frames in OpenGL, GLM
Announcements

- Assignment 2 now out.
- Start preparation for Midterm 1
- Resources for help
  - Re-read your notes, lecture notes, and textbook now
  - Prof. Pai’s regular office hour (ICICS X853): W 3-4 (from next week)
  - Extra office hour: Thursday Feb 6, 11-11:50. Don’t wait till the last minute! May have to go to hospital at short notice!
  - TAs can also help with theory during lab hours! You can drop in on any of the labs.
Assignment 2 demo
C³: Moving an Object

- The output on the screen corresponds to

\[ O = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad \overrightarrow{\delta t} = \overrightarrow{w}^t O \]

- Which of the following outputs corresponds to

\[ O = \begin{bmatrix} \cos \frac{\pi}{4} & -\sin \frac{\pi}{4} & 0 & 0 \\ \sin \frac{\pi}{4} & \cos \frac{\pi}{4} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \]

a)  

b)  

c)  

d)
GLM revisited

- Recall: implements GLSL math functions in C++
- Also includes utilities to create transformation matrices deprecated in new OpenGL
  - glm::rotate
  - glm::lookAt
  - glm::perspective
- `#include <glm/gtc/matrix_transform.hpp>` to use
- Pass matrix to shader using glm::value_ptr
A closer look at “lookAt”

- Book description in 5.2.3 has a bug, fixed in online Errata (make this and other corrections in your textbook copy)
  - \( z = \text{normalize}(p - q) \)
  - \( x = \text{normalize}(u \times z) \)
  - \( y = (z \times x) \)
C³ Exercise: Transformation

- Compute the transformation matrix that creates the following motion, all wrt the World frame. Rotate a point around the z axis by 90 degrees, and then scale the coordinates by $\frac{1}{2}$ in all directions, and then translate by (2, 1, 3).
C³ Exercise: Transformation

- Compute the transformation matrix that creates the following motion, all wrt the World frame. Rotate a point around the z axis by 90 degrees, and then scale the coordinates by ½ in all directions, and then translate by (2, 1, 3).

\[
\begin{bmatrix}
0 & -0.5 & 0 & 2 \\
0.5 & 0 & 0 & 1 \\
0 & 0 & 0.5 & 3 \\
0 & 0 & 0 & 1
\end{bmatrix}
\]

\[
\begin{bmatrix}
0 & -0.5 & 0 & -0.5 \\
0.5 & 0 & 0 & 1 \\
0 & 0 & 0.5 & 1.5 \\
0 & 0 & 0 & 1
\end{bmatrix}
\]

\[
\begin{bmatrix}
0 & -0.5 & 0 & 1 \\
0.5 & 0 & 0 & 0.5 \\
0 & 0 & 0.5 & 1.5 \\
0 & 0 & 0 & 1
\end{bmatrix}
\]

\[
\begin{bmatrix}
0.5 & 0 & 0 & 1 \\
0 & -0.5 & 0 & 0.5 \\
0 & 0 & 0.5 & 1.5 \\
0 & 0 & 0 & 1
\end{bmatrix}
\]

\[
\begin{bmatrix}
\text{None of the above}
\end{bmatrix}
\]